PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 48487-PT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/CA 03/01624	International filing date *(day/month/year)* 24.10.2003	Priority date *(day/month/year)* 25.10.2002
International Patent Classification (IPC) or both national classification and IPC C22C1/10		
Applicant ALCAN INTERNATIONAL LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
11.05.2004	26.10.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Brown, A Telephone No. +49 89 2399-2563

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/CA 03/01624

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-19 as originally filed

Claims, Numbers

1-33 filed with telefax on 09.09.2004

Drawings, Sheets

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17,19-23
	No:	Claims	18,24-33
Inventive step (IS)	Yes:	Claims	1-17,19-23
	No:	Claims	18,24-33
Industrial applicability (IA)	Yes:	Claims	1-33
	No:	Claims	

2. Citations and explanations

   see separate sheet

1. The Prior Art

D1: LUCAS, STEPHENS, GREULICH: "The Effect of Reinforcement Stability on Composition Redistribution in Cast Aluminium Metal Matrix Composites" MATERIALS SCIENCE AND ENGINEERING, no. A131, 1991, pages 221-230, XP002270490 USA

2. Article 19 PCT

Claim 28 suggests that a cast composite having 10-25% vol B_4C particles that contains at least 0.2% Mg will exhibit substantially no aluminium carbide particles at the surfaces of the refractory particles (B_4C). This is however not supported by the description which states on page 19 that (referring to example 5) that figure 3 which represents the composite material with no Ti added shows substantial attack on the B4C and reacted aluminium carbide crystals are evident. Figure 4 however, which represents the composite material with 1%Ti, shows less attack on the particles. Thus it is concluded that Ti must be present in order to prevent attack of the particles and hence the formation of aluminium carbide.

2. Claims 1-23 - A Method of Manufacture

None of the prior art discloses a method of manufacture that contains all of the features as given in claim 1. Accordingly, the subject matter of claim 1 and the dependent claims 2-17 and 19-23 are novel.

D1 concerns B_4C reinforced Al alloys and describes a method of manufacture that consists of :

i. A method of preparing a cast A356 alloy Al matrix composite consisting of:
- melting of the A356 Al matrix alloy which has a composition 7% Si, 0.35% Mg, 0.2% Ti, balance Al.
- adding 25% vol% B4C particles to a melt of said alloy

- mechanically stirring mixture to promote wetting
- stir casting

ii. A final product which is the said alloy reinforced with 25% vol B_4C particles in the form of bars. (See p. 222-223 and tables 1 and 2)

The difference between the method described in claim 1 with that disclosed in D1 is that the Mg content of the alloy is kept at below 0.2% at least until the said volume fraction of B_4C composite particles are distributed throughout the volume of the melt. The effect of this process step is to ensure that sufficient fluidity is maintained for casting.

Starting from D1, none of the available prior art indicates that the fluidity of the molten composite mixture of D1 could be improved by maintaining a low Mg level until after the B_4C particles are evenly distributed within the molten alloy. Accordingly, the subject matter of claim 1 and the dependent claims 2-17 and 19-23 are inventive.

Claim 18 is written as an independent claim for a method whereby the fluidity is maintained by addition of 0.2-5% wt. of Ti. D1 discloses all the features of claim 18 and therefore the subject matter of claim 18 lacks novelty (Article 33(2)PCT).

2.1 Claims 24-33 - A Cast Composite

D1 discloses a cast composite product that consists of an Al 356 matrix having the composition 7.0% Si, 0.35% Mg, 0.2%Ti, 0.15% Fe and the balance Al, which contains 25% vol of B_4C particles. Additionally it is disclosed that the Ti forms stable compounds, namely Ti boride compounds around the surface of the B_4C particles.

Accordingly, the subject matter of claims 24,26-27,29-33 lack novelty with respect to D1.

The subject matter of claim 25 would not appear to contain anything that could be considered new and inventive as the invention relates to the control of the Mg content during processing and to the Ti content of the melt.

CLAIMS:

1. A method of preparing a cast composite material, comprising the steps of: providing an aluminum-based matrix alloy; preparing a molten mixture of from about 10 to about 40 volume percent of free-flowing boron carbide particles and from about 90% to about 60 volume percent of a melt of said aluminum-based matrix alloy; stirring the molten mixture to wet the matrix alloy to the boron carbide particles and to distribute the particles throughout the volume of the melt; and casting the molten mixture to form a cast composite material;

characterized by maintaining the fluidity of the molten mixture by limiting the Mg in the aluminum-based matrix alloy to below 0.2% by weight, at least until completion of said distribution of said particles throughout said volume of the melt.

2. A method according to claim 1, characterized in that the mixture is prepared with an amount of said boron carbide within the range 10 to 25 volume percent.

3. A method according to any one of Claims 1, characterized in that the mixture is prepared with an amount of said boron carbide within the range 15 to 20 volume percent.

4. A method according to any one of Claims 1 to 3, characterized by limiting said magnesium content to less than 0.1% by weight.

5. A method according to any one of Claims 1 to 3, characterized by limiting said magnesium content to less than 0.05% by weight.

6. A method according to any one of Claims 1 to 5, characterized in that the melt is prepared with a matrix alloy that is either an AA1000 type alloy or an aluminum alloy comprising 5 to 10 % by weight Si.

7. A method according to any one of Claims 1 to 6, characterized in that further magnesium is added to the molten mixture a short time before casting.

8. A method according to Claim 7, characterized in that the amount of said further magnesium added to the molten mixture raises the magnesium concentration in the aluminum matrix alloy to between 0.2% and 0.8% by weight.

9. A method according to Claim 7, characterized in that the further magnesium is added in a casting trough or in a transfer ladle.

10. A method according to any one of Claims 7 to 9, characterized in that the mixture is further stirred after the addition of the magnesium.

11. A method according to any one of Claims 7 to 10, characterized in that the aluminum alloy employed to prepare the mixture is selected from the group consisting of AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloys.

12. A method according to any one of claims 7 to 11, wherein molten mixture is cast within 20 minutes of adding the further magnesium.

13. A method according to Claims 1, characterized in that the molten mixture contains Ti in an amount of at least 0.2% by weight but no more than 5% by weight.

14. A method according to Claim 14, characterized in that further magnesium is added to the molten mixture to

raise the magnesium concentration in the aluminum matrix alloy to between 0.2% and 1.4% by weight.

15. A method according to Claim 13 or Claim 14, characterized in that the aluminum alloy is selected from the group consisting of AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloys with added titanium.

16. A method according to Claim 13 or Claim 14, characterized in that the aluminum matrix alloy is an AA1xxx alloy with added titanium.

17. A method according to Claim 14, characterized in that the molten mixture is cast within 30 minutes of adding the further magnesium.

18. A method of preparing a cast composite material, comprising the steps of: providing an aluminum-based matrix alloy; preparing a molten mixture of from about 10 to about 40 volume percent of free-flowing boron carbide particles and from about 90% to about 60 volume percent of a melt of said aluminum-based matrix alloy; stirring the molten mixture to wet the matrix alloy to the boron carbide particles and to distribute the particles throughout the volume of the melt; and casting the molten mixture to form a cast composite material;

characterized by maintaining the fluidity of the molten mixture by providing at least 0.2% by weight but no more than 5% by weight of Ti in the aluminum-based matrix alloy.

19. A method according to any one of claims 1 to 18, characterized in that the cast mixture is remelted and cast into a shape.

20. A method according to any one of claims 1 to 18, characterized that the cast mixture is extruded into a shape.

21. A method according to any one of claims 1 to 18, characterized that the cast mixture is rolled.

22. A method according to any one of claims 1 to 18, characterized that the cast mixture is forged.

23. A method according to any one of claims 1 to 18, characterized that the cast mixture is formed into a neutron absorbing material.

24. A cast composite product comprising an aluminum alloy matrix having between 10 and 40 volume percent of boron carbide refractory particles dispersed therein, said composite containing at least 0.2 weight percent but no more than 5 weight percent titanium, said titanium forming a stable titanium-containing compound on the surface of the boron carbide particles that is not dispersed in the matrix and prevents attack by the aluminum alloy in the matrix, and the aluminum alloy matrix having an as-cast microstructure.

25. A cast composite product according to Claim 24, wherein the aluminum alloy matrix is an AA1xxx alloy.

26. A cast composite product according to Claim 24, wherein the aluminum alloy matrix contains at least 0.2 weight percent magnesium.

27. A cast composite product according to Claim 24, wherein the aluminum alloy matrix is an AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloy.

28. A cast composite product comprising an aluminum alloy matrix having between 10 and 25 volume percent of boron carbide refractory particles dispersed therein, said composite containing at least 0.2 weight percent magnesium, said composite exhibiting substantially no aluminum carbide crystals at the surfaces of the refractory particles when examined metallographically, and the aluminum alloy matrix having an as cast microstructure.

29. A cast composite according to Claim 28, wherein the aluminum alloy is an AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloy.

30. A cast composite according to Claim 28, wherein the composite contains no more than 0.8 weight percent magnesium.

31. A cast composite product comprising an aluminum alloy matrix having between 10 and 40 volume percent of boron carbide refractory particles dispersed therein, wherein the aluminum alloy matrix contains at least 0.2 weight percent magnesium, the composite contains at least 0.2 weight percent titanium but no more than 5 weight percent, said titanium forming a stable titanium-containing compound on the surface of the boron carbide particles that is not dispersed in the matrix and prevents attack by the aluminum alloy in the matrix, and the aluminum alloy matrix has an as cast microstructure.

32. A cast composite according to Claim 31, wherein the aluminum alloy is an AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloy.

33. A cast composite according to Claim 31, wherein the aluminum alloy matrix contains no more than 1.4 weight percent magnesium.